

# **REPORT OF THE THIRD MEETING OF THE ILC PROJECT ADVISORY COMMITTEE (PAC)**

2/3 November 2009; Pohang, Korea

**Committee:** Jean-Eudes Augustin, Paris (Chair); Jon Bagger (ILCSC Chair—ex officio); Lyn Evans, CERN; Günther Geschonke, CERN; Akira Masaike, Kyoto; Robert Orr, Toronto; Raj Pillay, TIFR; Roy Rubinstein, Fermilab (Secretary); Masakazu Yoshioka, KEK.

Apologies: Don Hartill (attended partly by phone), Steve Holmes.

## **1. Introduction**

The ILC Project Advisory Committee (PAC) was formed in 2008 to assist the International Linear Collider Steering Committee (ILCSC) in the ILCSC's oversight of the Global Design Effort (GDE) activities on ILC accelerator design and also of the ILC detector activities. The PAC mandate is given in Appendix I.

The third meeting of the PAC took place on 2/3 November 2009 at the Pohang Accelerator Laboratory (PAL), Pohang, Korea. The PAC is very appreciative of the excellent hospitality and hard work of the PAL staff which made this meeting possible. It consisted of two days of presentations on the ILC accelerator status and plans and on the status and plans for ILC detectors. The Committee is also very grateful to the presenters and the leadership of the accelerator and detector efforts for all of their work to allow this evaluation of their activities. The meeting agenda is given in Appendix II, and the presentations to the Committee are in Appendix III.

## **2. Accelerator Reports Presented to the PAC Meeting**

A. Barry Barish gave the GDE project status, and also provided responses to the PAC and AAP reviews of Spring 2009. He described the major R&D goals for TDP1, including a cavity gradient demonstration with 50% yield by 2010; yields from qualified vendors are now in the several 10s of % at 35 MV/m. He discussed the tests underway at CesrTA, ATF2 and FLASH; the FLASH tests have produced beam parameters very close to those required for the ILC. Barish gave a timeline for re-baselining of the accelerator design, and already a "Strawman Baseline" (SB2009) has been produced. SB2009 has a single accelerator tunnel, the positron undulator source at the 250 GeV end of the electron linac, a 3.2 Km damping ring, and a reduced parameter set; the total cost savings from the RDR are ~ 10-15%, ensuring cost containment in the TDR

phase. Barish also discussed ILC-CLIC activities, and preliminary thoughts for the period beyond 2012.

In answer to questions, Barish noted no changes in the ability to upgrade to 1 TeV between the TDR and SB2009. He also commented on recent statements by US DOE officials on the ILC cost.

B. More detail on SB2009 was given by Marc Ross. The primary accelerator cost driver is conventional facilities, and a reduction in underground tunnel volume and cooling requirements leads to cost savings. In order to have a single accelerator tunnel, solutions must be found to the high level rf distribution, and 2 promising proposals (klystron cluster layout and distributed rf scheme) have been made; a preliminary conclusion is that a single tunnel solution is viable, and would add only ~ 1% to the accelerator downtime. Ross also discussed each of the other major changes between the RDR and SB2009.

In answer to questions, Ross said that the low power option would lead to a ~ 35% operating cost reduction. Communications with the detector community have started on how the low-power option impacts the experiments. Placing the positron source at the end of the electron linac will affect operation at center of mass energies below ~ 250 GeV, and will have to be studied further.

C. Akira Yamamoto reviewed the progress on SCRF, and gave the goals for this work. There is now a “standard recipe” for cavity processing, and a better definition of cavity yield; the yield at 35 MV/m is now 22% at the first pass and 33% at the second pass. Yamamoto described the cavity production status in each of the 3 regions, and the re-baselining proposal: 31.5 MV/m operational at  $Q_0=1E10$ ; 35 MV/m in vertical test at  $Q_0=8E9$ ; production yield 90% at 28 MV/m and 50% at 35 MV/m. He noted the recent GDE visits to industrial cavity producers, and the need to specify the definition of “plug compatibility”.

Questions to Yamamoto centered on the details of “plug compatibility”.

D. Project Implementation and Resources were discussed by Mike Harrison, who gave goals and timelines; a Project Implementation Plan is expected by Summer 2011, and a final version at the end of the TDP phase in 2012. Harrison commented that several groups are now working on ILC governance models, and a preliminary report on this is expected by summer 2010. He discussed project funding models, and the importance of sufficient cash contributions in addition to the expected majority of contributions in-kind.

E. Kaoru Yokoya discussed the test facilities CsrTA, ATF and ATF2. There have been 2 runs on CsrTA since the last PAC meeting, with a world-wide collaboration studying electron cloud issues, and Yokoya described the equipment and schedules. The ILC damping ring parameters are not exactly reproduced by CsrTA, and comparison with simulation is essential. Yokoya discussed various electron cloud mitigation proposals.

On ATF, the highest priority has been to reproduce the emittances achieved in 2003, and some progress has been made towards this goal. Tests with the fast kicker have successfully achieved

both single and multi-bunch extraction. Yokoya described the current status of beam size measurements in ATF2.

F. The Machine-Detector Interface (MDI) from the accelerator perspective was covered by Andrei Seryi. Now that there are only 2 detectors to consider rather than the previous 3, the MDI design possibilities are reduced, and detailed studies of detector stability and the QD0 supports for each of the 2 detectors have started. BNL and KEK are working on the design of the final doublet cryostat and cryosystem, and BARC and SLAC are working on the 18 MW beam dump. Seryi described the changes to the BDS optics from the RDR to SB2009.

G. Jean-Pierre Delahaye described the ILC-CLIC collaboration. The aims are to make the best use of available resources, focus on subjects with strong synergy, adopt systems as close as possible, and develop a common knowledge of both designs and technologies. He listed the 7 ILC-CLIC working groups, together with the plans for each; the first meeting of the Joint Working Group on Accelerator General Issues will be in November 2009. Delahaye gave the schedule for CLIC: CDR at the end of 2010; CERN Council decision in mid-2011; TDR1 at the end of 2012; TDR2 at the end of 2016. His conclusion was that ILC-CLIC collaboration is valuable for both groups and is a major step towards a future linear collider

### 3. **Detector Reports Presented to the PAC Meeting**

A. Research Director Sakue Yamada reviewed the status of ILC detectors. Changes have been made to the Research Director's organization following the detector validation in August/September 2009, and the Common Task Groups have also been reorganized. Following the August 2009 ILCSC endorsement of the IDAG validation recommendations, the 2 validated groups (ILD and SiD) were notified, and at the Albuquerque meeting the community appeared to widely accept the outcome. A working group, led by Jim Brau, has been set up to study the impact of the SB2009 proposed accelerator design changes, and has sent a list of concerns and questions to the GDE. Yamada has felt that there needed to be a stronger connection between the Research Director's organization and the GDE Executive Board; this has now taken place with invitations to a part of GDE's meetings, and appears to be working.

Yamada gave a proposed time plan for the validated groups' future activities, and both groups are now working on detailed plans; IDAG will monitor these activities, and will soon formulate a detailed scenario to do so. Financial support for detector activities is not clear for the coming years. Yamada said that discussions are still needed with the detector R&D groups, which work independently of the validated detectors. Discussions have started with CLIC on cooperative detector activities

B. Michel Davier described IDAG activities over the past year, including its charge, validation criteria, meeting schedule, and major issues arising in the validation process. The IDAG recommendation was that ILD and SiD should both be validated; there is a large amount of complementarity between these 2 detectors. The 4<sup>th</sup> Concept was not validated, but IDAG recommended that dual-readout calorimetry should be supported in view of its potential for

higher energy colliders. IDAG has now completed the first phase of its requested work, and will in future monitor the progress of the detailed design of ILD and SiD and the accompanying R&D effort.

C. The major activities of the Physics Common Task Group over the past year, presented by Michael Peskin, included the relation between LHC physics and the case for ILC; the possibility of a staged realization of the ILC; ILC capability for precision Higgs physics; and suggestions for key benchmark processes for ILC studies in 2010.

D. Activities of the Detector Common Task Group were discussed by Marcel Demarteau. He listed 9 R&D collaborations and the R&D currently being pursued, noting the breadth of the program. His Common Task Group has identified a few key R&D areas where additional support is needed in order to have defensible detector designs in 2012. Demarteau defined and listed 5 areas of “high priority” R&D.

Demarteau said that a detector R&D plan is close to submission by his Group to the Research Director. He noted that the regional imbalance in R&D funding has become worse since the last PAC meeting, and he appealed for PAC and ILCSC support to obtain additional R&D funding.

In the subsequent discussion, the hard work of Demarteau’s group was commended as being very valuable. Lab directors’ support for detector activities is essential, and it was felt that this issue should be raised with lab directors at the February 2010 ILCSC meeting.

E. Akiya Miyamoto reported for the Software Common Task Group. He described the Group’s activities carried out in the LOI era, including the successful common data samples, and noted the software issues raised by SB2009. He gave a work plan for the period to 2012.

F. The Machine-Detector interface (MDI) Common Task Group report was given by Karsten Buesser. Major discussions since LOI validation have been on the push-pull scenario for the ILD and SiD detectors. Presently the design of ILD has the detector sitting on a platform, while SiD has no platform. This design difference leads to technical complications, although it seems possible; detector vibration issues are central to the push-pull issue, and vibration analyses are underway. SB2009 has raised many MDI issues, and Buesser mentioned the major ones; a list of questions has been sent to the GDE.

In answer to a question, Buesser noted the increased challenge of running at 250 GeV because of the movement of the positron source to the end of the electron linac.

G. Francois Richard discussed ILC-CLIC detector cooperation. He said that there is now increased technical collaboration; CERN has joined ILD and SiD and the major R&D collaborations, and has 10-12 FTEs working on linear collider detectors. Richard noted that the particle flow approach could be used at 3 TeV, but necessitates a thicker (and thus more costly) hadron calorimeter. A mandate for an ILC-CLIC detector general issues working group, as encouraged by ILCSC, is under final review by ILCSC. The ILC detector community has some concerns that ILC priorities and resources not be diverted by CLIC needs, and Richard noted that ILC-CLIC collaboration on detectors may be viewed differently in the 3 regions. There is also

some concern in the ILC detector community about the possibility of a 500 GeV version of CLIC.

#### 4. **PAC Summary and Recommendations**

##### Accelerator--1

1. In preparing for the review, The PAC found the ILC R&D Plan Version 4 a valuable document; the Committee looks forward to further such information prior to future PAC meetings.
2. The PAC is happy with the progress on Accelerator Design and Integration
3. Containment of the accelerator costs is very valuable, and the PAC supports the re-baselining process. In this re-baselining, good communications with the detector community is essential, and the recent working group set up on this topic is very useful.
4. The single tunnel concept relies on revised rf distribution systems, and further assessment of this is needed before a final decision. The PAC looks forward to hearing the AAP's judgment on the rf system proposals by May 2010.
5. The PAC is pleased with the progress on SCRF activities and the work on the yield determination. It appears possible to meet the goal of 50% yield in 2010.
6. The PAC supports cavity design variations in the R&D phase, but believes that there should be a common final cavity design.
7. Activities towards industrialization appears to be progressing.
8. Results from the test facilities (CesrTA, ATF, ATF2) are going well. The PAC supports extension of the CesrTA running, and believes that these studies are useful also for the broader physics community. The successful extraction of the beam at ATF with the prototype fast kicker is a great step forward. The Committee looks forward to the analysis of the successful high current FLASH tests.
9. The MDI work has been excellent, and the PAC appreciates the help to the detector groups in answering IDAG questions.
10. The work on common ILC/CLIC activities, in particular concerning technical issues in the R&D phase, is very positive.

##### Accelerator--2

Following the GDE presentations, the PAC had several questions about the re-baselining which may be better answered over the next few months. The PAC suggests that the AAP could study them for its January 2010 review; the PAC would appreciate very much the results of such studies. The questions are as follows.

1. Why are the cost savings only ~ 3% in going from 2 tunnels to 1? Do such seemingly small savings justify the increased reliability risks inherent in a single tunnel scheme? Also, why are the cost savings only ~ 3% in going from ~6 Km damping rings to ~ 3 Km ones?
2. How feasible are each of the two rf distribution systems proposed for the single tunnel option?
3. What is the effect on the electron beam emittance of having the positron source at the end of the electron linac? What is the effect of this positron source location on the experiments when they run at cm energies below ~ 250 GeV?

4. How is the lack of significant R&D on the undulator positron source affecting confidence in this source design?
5. How practical is the traveling focus concept, and what studies give confidence in its use in the ILC?
6. Are there any concerns about the apparent complexity of the proposed tunnel layout in the BDS/DR/IR region?
7. How much can one rely on the program evaluating the machine availability?

#### Detectors

1. The PAC is impressed with the significant and efficient work carried out by the IDAG on the detector validation. It also notes the recent definition of IDAG activities through 2012.
2. The speedy formation of the SB2009 group to discuss detector-accelerator issues following from the re-baselining activities is to be commended.
3. The PAC is pleased to see the recent strengthening of links between the RD organization and the GDE.
4. The Physics Common Task Group has been carrying out useful work on strengthening the physics case for the ILC.
5. The excellent work of the Detector R&D Common Task Group on selecting key R&D for the 2012 deadline is noted. The PAC recommends that ILCSC work to increase support from the lab directors and from the funding agencies for ILC detector R&D.
6. The Software Common Task Group is working well and efficiently.
7. The PAC is impressed with the MDI Common Task Group's efforts to reach common detector/accelerator solutions, and solutions common to both the SiD and ILD detectors. The vibration studies should continue, aiming at more commonality of movement systems between the two detectors.
8. The PAC notes the progress being made on ILC-CLIC detector issues.

5. **Next PAC Meeting**

The next PAC meeting will be take place in Valencia, Spain, on 13/14 May 2010.



## **Appendix I**

### ILC Project Advisory Committee (PAC) Mandate

1. The International Linear Collider Steering Committee (ILCSC) is responsible for the oversight of the Global Design Effort (GDE) activities and of the ILC experimental program.
2. PAC will assist ILCSC in this function and report to the ILCSC.
3. PAC will review the GDE accelerator activities and, in addition, the ILC detector activities.
4. In its review activity, PAC will examine the overall consistency and realism of the project, in relation to physics, technical design, cost, and schedule.
5. PAC shall comprise about nine members, appointed by the ILCSC for terms of two or three years, and will meet a few times per year until the completion of the Technical Design Phases I and II.
6. The PAC Chair will be appointed by the ILCSC, normally for a two-year term.

## **Appendix II**

### PAC Meeting Tentative Agenda

2/3 November 2009

Room 201, Administration Building, Pohang Accelerator Laboratory  
Pohang, Korea

#### Monday 2 November

08:30 Executive Session  
09:00 GDE Report (including AAP/PAC responses) --- Barry Barish (60 + 20)  
10:20 Break  
10:35 Proposed New GDE Baseline --- Ewan Paterson (45 + 15)  
11:35 Executive Session  
12:15 Lunch  
13:15 SCRF (including industrialization) --- Akira Yamamoto (45 + 15)  
14:15 Project Implementation, Resources --- Mike Harrison (30 + 10)  
14:55 Test Facilities --- Kaoru Yokoya (30 + 10)  
15:35 Break  
15:50 MDI---Andrei Seryi (30 + 10)  
16:30 GDE Cooperation with CLIC --- Jean-Pierre Delahaye (30 + 10)  
17:10 LOI Validation --- Michel Davier (by telephone/video) (30 + 10)  
17:50-19:30 Executive Session; Accelerator Closeout

#### Tuesday 3 November

08:30 Executive Session  
09:00 RD Report (including detector activity plan) --- Sakue Yamada (60 + 10)  
10:10 Physics Common Task Group --- Michael Peskin (by telephone/video) (30 + 10)  
10:50 Break  
11:05 Detector R&D Common Task Group --- Marcel Demarteau (30 + 10)  
11:45 Software Common Task Group --- Akiya Miyamoto (30 + 10)  
12:25 Lunch  
13:25 MDI-D Common Task Group --- Karsten Buesser (by telephone/video) (30 + 10)  
14:05 Detector Cooperation with CLIC --- Francois Richard (by telephone/video) (30 + 10)  
14:45 Executive Session  
15:45-16:15 Detector Closeout

## **Appendix III**

The presentations given to the PAC are available at

<http://www.fnal.gov/directorate/ILCPAC/ILCPACNov2009/AttachmentsILCPACNov2009.htm>